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"Experimental Researches in Electricity." By Michael Faraday, Esq., D.C.L., F.R.S., &c. Nineteenth Series. Section 25: On the Magnetization of Light, and the Illumination of Magnetic Lines of Force.

For a long time past the author had felt a strong persuasion, derived from philosophical considerations, that among the several powers of nature which in their various forms of operation on matter produce different classes of effects, there exists an intimate relation; that they are connected by a common origin, have a reciprocal dependence on one another, and are capable, under certain conditions, of being converted the one into the other. Already have electricity and magnetism afforded evidence of this mutual convertibility; and in extending his views to a wider sphere, the author became convinced that these powers must have relations with light also. Until lately his endeavours to detect these relations were unsuccessful; but at length, on instituting a more searching interrogation of nature, he arrived at the discovery recorded in the present paper, namely, that a ray of light may be electrified and magnetized; and that lines of magnetic force may be rendered luminous.

The fundamental experiment revealing this new and important fact, which establishes a link of connexion between two great departments of nature, is the following. A ray of light issuing from an Argand lamp is first polarized in the horizontal plane by reflexion from a glass mirror, and then made to pass, for a certain space, through glass composed of silicated borate of lead, on its emergence from which it is viewed through a Nichol's eye-piece, capable of revolving on a horizontal axis, so as to intercept the ray, or allow it to be transmitted, alternately, in the different phases of its revolution. The glass through which the ray passes, and which the author terms the *diamagnetic*, is placed between the two poles of a powerful electro-magnet, arranged in such a position as that the line of magnetic forces resulting from their combined action shall coincide with,

or differ but little from the course of the ray in its passage through the glass. It was then found that if the eye-piece had been so turned as to render the ray invisible to the observer looking through the eye-piece before the electric current had been established, it becomes visible whenever, by the completion of the circuit, the magnetic force is in operation; but instantly becomes again invisible on the cessation of that force by the interruption of the circuit. Further investigation showed that the magnetic action causes the plane of polarization of the polarized ray to rotate, for the ray is again rendered visible by turning the eye-piece to a certain extent; and that the direction of the rotation impressed upon the ray, when the magnetic influence is issuing from the south pole, and proceeding in the same direction as the polarized ray, is right-handed, or similar to that of the motion of the hands of a watch, as estimated by an observer at the eye-piece. The direction in which the rotation takes place will, of course, be reversed by reversing either the course of the ray or the poles of the magnet. Hence it follows that the polarized ray is made to rotate in the same direction as the currents of positive electricity are circulating, both in the helices composing the electro-magnet, and also in the same direction as the hypothetical currents, which, according to Ampère's theory, circulate in the substance of a steel magnet. The rotatory action was found to be always directly proportional to the intensity of the magnetic force, but not to that of the electric current; and also to be proportional to the length of that portion of the ray which receives the influence. The interposition of substances which occasion no disturbance of the magnetic forces, produces no change in these effects. Magnets consisting only of electric helices act with less power than when armed with iron, and in which magnetic action is consequently more strongly developed.

The author pursues the inquiry by varying in a great number of ways the circumstances in which this newly-discovered influence is exerted; and finds that the modifications thus introduced in the results are all explicable by reference to the general law above stated. Thus the effect is produced, though in a less degree, when the polarized ray is subjected to the action of an ordinary magnet, instead of one that derives its power from a voltaic current; and it is also weaker when a single pole only is employed. It is, on the other hand, increased by the addition of a hollow cylinder of iron, placed within the helix, the polarized ray traversing its axis being then acted upon with great energy. Helices act with equal power in any part of the cylindric space which they enclose. The heavy glass used in these experiments was found to possess in itself, no specific magneto-inductive action.

Different media differ extremely in the degree in which they are capable of exerting the rotatory power over a polarized ray of light. It is a power which has no apparent relation to the other physical properties, whether chemical or mechanical, of these bodies. Yet, however it may differ in its degree, it is always the same in kind; the rotation it effects is invariably in one direction, dependent, how-

ever, on the directions of the ray and of the magnetic force. In this respect it differs essentially from the rotatory power naturally possessed by many bodies, such as quartz, sugar, oil of turpentine, &c., which exhibit the phenomena of circular polarization; for in some of these the rotation takes place to the right, and in others to the left. When, therefore, such substances are employed as diamagnetics, the natural and the superinduced powers tend to produce either the same or opposite rotations; and the resulting effects are modified according as they are cumulative in the former case, and differential in the latter.

In the concluding section of the paper, the author enters into general considerations on the nature of the newly-discovered influence of electricity and magnetism over light, and remarks that all these powers possess in common a duality of character which constitutes them a peculiar class, and affords an opening which before was wanting for the appliance of these powers to the investigation of this and other radiant agencies. The phenomena thus brought to light confirm the views entertained by the author relative to the constitution of matter as being spheres of power, for the operation of which the conception of a solid nucleus is not necessary; and leads to the presumption that the influence of magnetism on bodies which exhibit no magnetic properties consists in producing in them a state of electric tension tending to a current; while on iron, nickel, and other bodies susceptible of magnetism, currents are actually established by the same influence.

The author states that he is still engaged in the prosecution of these inquiries.

"On the Action of the Rays of the Spectrum on Vegetable Juices:" being an Extract from a Letter by Mrs. M. Somerville to Sir John F. W. Herschel, Bart., dated Rome, September 20, 1845. Communicated by Sir John F. W. Herschel, Bart., F.R.S.

In the experiments of which the results are here recorded, the solar spectrum was condensed by a lens of flint glass of seven inches and a half focus, maintained in the same part of the screen by keeping a pin-hole or pencil-mark constantly at the corner of the red rays, which were sharply defined by being viewed through blue spectacles; and the apparatus was covered with black cloth in order to exclude extraneous light. Thick white letter-paper, moistened with the liquid to be examined, was exposed wet to the spectrum, as it was found that the action of the coloured light was thus rendered more immediate and more intense, than when the surface of the paper was dry.

The action of the spectrum at the junction of the lavender with the violet rays was found in some cases to be different from what it is with either of these colours separately, indicating a break in the continuity of action, and suggesting the idea of a secondary spectrum. In many instances the yellow and green rays exert a powerful influence on vegetable substances, an influence apparently unconnected with heat; for the darkening is generally least under